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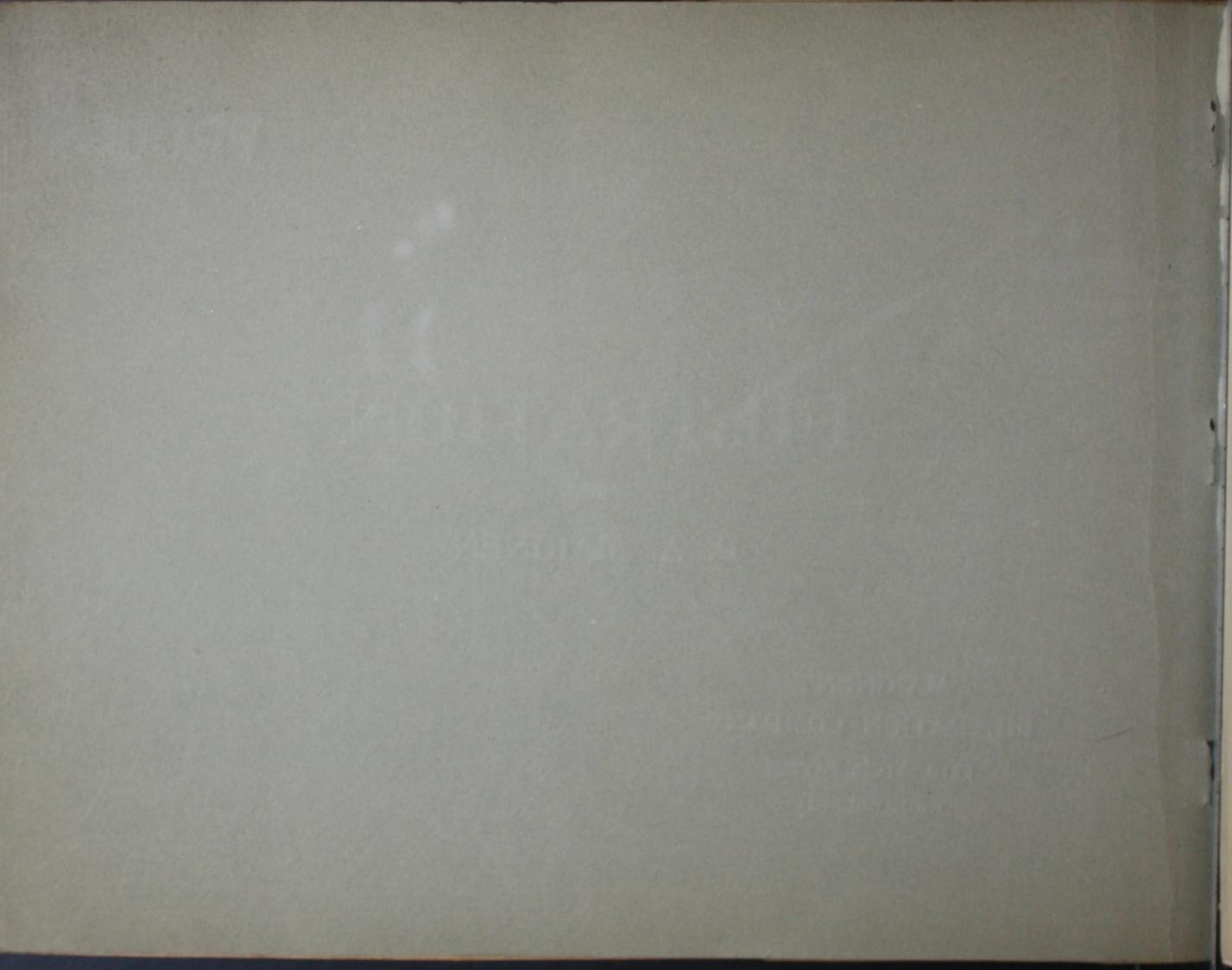
FILTRATION

.....BY.....

P. A. MAIGNEN

DEC 19 1909

MAIGNEN'S
FILTRATION COMPANY
1310 Arch Street
PHILADELPHIA



NATIONAL EXPORT EXPOSITION, PHILADELPHIA.

CIRCULAR NO. 7.

THE ONLY PRACTICAL FILTER

OCTOBER, 1899.



MAIGNEN FILTER

Asbestos Cloth and "Carbo-Calcis"

PROTECTED BY AMERICAN AND FOREIGN PATENTS

AWARDS

**THE ONLY FILTER THAT REALLY PURIFIES
WATER AND REMOVES.**

- 1st.—The toxins of pathogenic Microbes.
 - 2d.—*The Organic Matter in Solution* and in Suspension.
 - 3d.—The Soluble Metallic poisons, such as Lead, Iron or Copper.
 - 4th.—The bad taste of water.

THIS FILTER DOES NOT CONTAIN

- 5th.—Any element liable to be broken or put out of order.

THE MAIGNEN ENTER

- 7th.—Never becomes bad.
8th.—Always gives plenty of water.
9th.—Requires very little attention, and little or no expense to keep in order.

FILTRATION.—Filtration is generally defined as the process by which liquids are separated from substances mechanically suspended in them.

In the arts, filters have been used from time immemorial; the oldest filtering device known was made of felt. It is called in households "Jelly Bag," and among liquor dealers and druggists "Filter Bag," and "Hippocrates' Sleeve."

The word "filter" itself is etymologically traced in almost every language to the word "felt," *i. e.*, fulled wool. It is rendered in Anglo-Saxon, "felt;" in Swedish, "filt;" French, "filtre;" Italian, "feltro," and Latin, "filtrum" or "feltrum."

This invention, if we may call it so, has stood the test of very many centuries, and it has seemed to us worthy of investigation.

Filtration through felt is not a sieving action, but a capillary action.

In sieves made of silk, horse hair or wire gauze, the passages are fixed pores, the threads used to make the sieves have in themselves no filtering quality; when the meshes of the sieves are open, those particles which are smaller than them pass with the water, and when the meshes are choked nothing goes through.

In felt, on the contrary, there are no meshes, there are no fixed pores, the fibres are interlaced and lying so

close to one another that liquids can only pass by capillarity, as is the case with lamp wicks.

In felt or felted cloth the whole surface is effective; the speed of filtration is not due to large passages, but to their great number. It is therefore evident that the best and most rapid filtration of water ought to be obtained with felt.

Twenty years ago we started to filter water through felt, but we were thwarted and soon vanquished.

We tried every sort and quality of felt; after a very few days in water, the felt itself underwent putrid decomposition, and had to be given up.

Wool is organic matter; when in water, it soon becomes an easy prey to the busy microbes, and goes the way of all members of organic bodies cut off from the living trunk.

ASBESTOS FELT.—We then turned our attention to the making of felt or felted cloth with a material that would not be liable to decay in water, and we found asbestos to be this desirable material.

Asbestos (in French, Amiante) is a mineral, principally silicate of magnesia, not affected by acids nor water; fire itself has little effect on it. It is quarried in the shape of small stones, and when broken up under heavy rollers and carded, it takes the appearance of raw cotton.

This stone turns out to have been formed by nature of microscopic fibres, many times finer than silk, cotton or wool, and having a much greater textile strength.

The Romans of old knew how to weave it, and used it to save the ashes of their burnt dead, as is now done in modern crematories.

The art of weaving asbestos had been lost during many centuries. It has been recovered in our own day, and the late Mr. H. W. Johns, of New York, was perhaps the very first modern manufacturer to restore the art.

We have now a perfect felted asbestos cloth, which we use in our domestic filters, in public drinking fountains and in public water purifying plants.

Figure 1 shows one of our improved complete asbestos filtering organs. Figure 2 represents the core or inner part of the said filtering organ. The fluffy nature of the felted asbestos cloth is here very apparent, and it is easy to understand how the filtration may be rapid and perfect at the same time. The water passes from the exterior to the interior of the asbestos felted cloth. The suspended impurities are retained on the outer surface and are easily washed off.

The space between the outer asbestos cloth seen in Figure 1, and the inner asbestos cloth of Figure 2 is filled with "Carbo-Calcis," a special charcoal which retains and oxydises the dissolved organic matter and metallic poisons

as also the bad gases. This combination is the best thing known for producing the maximum of purification with the minimum of material; every particle of it is effective.

The water may be said to be four times filtered, as it goes through four layers of purifying materials: two asbestos cloths and two layers of charcoal.

SAND.—Sand filter beds have been in use in England since 1829. Figure 3 shows a section of one of these filter beds made up of various layers of different materials.

Figure 4 shows another sand filter bed with less variety of material, according to German practice.

In all cases the finest sand is on the top, the underlying strata, made of progressively coarser material, act as support for the sand.

The voids between the grains of the sand are estimated to be about one third of the space occupied by the sand. Thus a tank capable of containing nine cubic feet of sand can also contain in the interstices thereof three cubic feet of water.

The average size of the grains of fine sand used in filter beds is about .013 inch diameter.

The voids, spaces or passages between them would therefore be about .004 inch.

The dimensions of the pathogenic microbes are:

	LENGTH. INCH.	THICKNESS. INCH.
Cholera, - -	.000118 to .000157	.000031 to .000078
Typhoid, - -	.000078 to .000118	.000012 to .000019
Diphtheria, - -	.000078 to .000118	.000019 to .000031

It is therefore quite possible that these micro-organisms should pass through the *ordinary* sand bed, particularly when it is quite new, or immediately after it has been cleansed.

It has been noticed that as filtration goes on through the sand beds, the filtrate becomes better and better, fewer colonies are found in it, and less species. The fine particles of clay or other earths, of vegetable and animal matters, the micro-organisms themselves, little by little, crowd the voids between the grains of sand to a depth of half an inch or more, and constitute what is now held to be the true filtering membrane or *real filter*.

In sand filtration plants, comprising settling reservoirs, provision is made to send undecanted water on the freshly cleansed filter beds, so as to form in a shorter time this filtering membrane.

In other installations instructions are given to send to waste the water filtered during the first day or two, to give

time for the membrane to form before the filtrate is considered fit to be sent into the drinking water mains.

All who have watched the workings of sand filters know how delicate is the so called filtering membrane formed by the mud, how unpurified water passes between the retaining walls and the sand and also through cracks and fissures in other parts of the beds. Another weak point, in sand filtration, is the great quantity of sand which gets dirty and has to be taken out of the filter each time it is cleansed.

ASBESTOS FELT AS A FILTERING MEMBRANE FOR SAND FILTERS.

—It has occurred to us, that by depositing on the surface of the sand a layer of asbestos fibre and thus making an *asbestos felt membrane*, we would perfect sand filtration to a point equal to that given by our small filters, and correct the greatest defects of the English and German sand processes. The asbestos fibres are extremely fine, —.000015 inch, the passages therefore between them are much finer and very much more numerous than those between the particles of sand, and thus, by this combination, we obtain a *better* and *faster* filtration.

Moreover, the mud being arrested on the surface of the asbestos felt membrane, the underlying sand is kept practically clean.

OUR EXPERIMENTAL PLANT IN PHILADELPHIA, Figures 5 and 6, represent the experimental plant which we have erected on our own premises, 1310 Arch Street, Philadelphia, to watch, day by day, in all seasons of the year, the behaviour of the Schuylkill water under process of filtration.

Glass windows, on the side of our tanks, allow us to see what takes place in the body of the filtering materials. The taps on the end of the tanks enable us to test the purifying action of the different layers of filtering material.

Our tests are made not only on the color, taste and appearance of the water, but also on the speed of filtration, on the period of runs between cleansings and on numerous other points of interest. We watch the bacteriological and chemical qualities of the filtered water in our own laboratory (Figure 7).

We also observe the behaviour of the different kinds of sand in different thicknesses. Figure 8 shows a section of a sand filter bed with a layer of asbestos fibre deposited on the top.

In Figure 9 can be seen, if looked at with a magnifying glass, a great number of caverns and holes which are filled with air, [air, as is well known by all water engineers, is a great factor for evil in the art of filtration.]

We have introduced, in our complete system, remedies to this and several other defects, for protecting which we have applied for patents.

With our experimental plant and our series of sample taps, we have demonstrated that the real work of filtration is done by the asbestos felt membrane and by the finer sand.

All the coarse material beneath acts only as support for the fine sand, and is absolutely unnecessary.

We have also proved that a head of water from 9 to 12 inches gives the best results. The head of 3 to 6 feet, usually resorted to in ordinary sand filters compresses the sand too much or opens up channels, cracks or fissures.

CONCLUSION.

The result of our experience is that a sand filter bed two or two and a half feet thick gives the best effluent and the greatest quantity of pure water. And thus it is that we have designed our filters with a total height of 3 feet 3 inches and a head of water of 9 inches over the sand.

It will be easily understood, that with filters 12 feet deep, the walls have to be so strong, so wide, and so heavy, that it is altogether impracticable to build them on the top of one another, and that on the contrary with our reduced depth we can adopt the modern steel, concrete

and cement mode of construction, and build two or three filter beds on the top of one another.

Thus it is that in the City of Philadelphia, if the English slow sand filters had to be erected, a vast extent of land would be required, say 160 acres.

Our asbestos felt membrane allows us to obtain a speed that is four times greater than that of the ordinary sand beds. If we establish two decks of filters this reduces the necessary area of land to one eighth. With three decks, a twelfth of the space is sufficient.

Thus it is that we can find on the banks, or near the present reservoirs, enough land belonging to the city to erect our filter plants.

Another advantage of our invention is that with this arrangement the second floor acts as covering for the first filter bed, the third floor for the second filter bed, and one roof does for two or three filter beds.

The troubles of open sand beds in a climate like that of Philadelphia are so great that the advantages of covering and enclosing them will be fully realized.

We give herewith reduced plans of the locations of our Municipal Filter Houses for Philadelphia, as also a side elevation of a three deck filter plant with our latest improvements.

CHERBOURG WATER SUPPLY.—The City of Cherbourg on the north coast of France has 42,000 inhabitants—34,000 civil and 8,000 military.

The water supply comes from a small creek "The Divette," which receives the surface water from high pastoral and cultivated slopes. At all times, the water is yellow from the iron and clay soil, and in times of freshets it contains an unusual amount of mud.

Typhoid fever, and all other diseases due to impure water were endemic, and the water question had been a subject of acute anxiety for years. The Army and Navy Departments had often threatened to withdraw the troops if some better water supply were not provided by the city.

A municipal commission was sent to London to study the system of water filtration applied there. The administration did not see its way clear to apply the London sand filtration process for several reasons, the principal being the necessity of building large settling reservoirs, and the space required for the filter beds themselves.

We proposed our asbestos filters, and ten public filtering fountains of our asbestos system were erected in the different parts of the city in December, 1893. These gave satisfaction to the public. Having a reservoir of 200 gallons of filtered water, and a filtering capacity of 100 gallons per hour, housewives found at all hours of the day

at the Maignen Fountains, all the water required for the family.

One year later the Municipal Council determined to apply our asbestos process to the whole water supply. Plans and estimates were submitted, and the contract was awarded us in July, 1894, for a plant capable of purifying 3,000,000 gallons of water per 24 hours. The installation was completed in September, 1895, and has been at work ever since, fulfilling in a perfect manner the conditions stipulated.

EXTRACT FROM A LETTER FROM THE MAYOR OF CHERBOURG, FRANCE, IN DATE OF MAY 24TH, 1896:

"The water supply of Cherbourg comes from a river which is very dirty in rainy times. The City was seeking since a long time, a practical, efficacious and relatively economical means to improve this water.

"Various systems had been examined; a Municipal Commission was sent to London to examine the sand filtration of the Thames River. Experiments (on the London plans) were made by the administration, which was then more perplexed than ever.

"Mr. Maignen came and proposed filters of his system, wherein the water passes through asbestos cloth and charcoal. Experiments made with apparatus of this nature, having given excellent results, the Municipal Council decided to supply ten districts, or wards of the City with a public filtering fountain of this system in order to complete and prolong its observations.

"After several months' working of these fountains, the population showed itself quite satisfied. The Municipal administration resolved to proceed to the purification of all the water of the reservoir which supplies the City.

"A contract was made with this object with Mr. Maignen, and since the installation of these filters, before last winter, a quantity of water sufficient for the requirements of the City is served very clear by the distributing system.

This quantity could be easily augmented, if necessary, by increasing the number of apparatus.

"Filtration, according to the Maignen system, asbestos cloth and Carbo-calcis, gives, I repeat, very good results. This process is assuredly one of the best that is known. It has the advantage of an economical installation; the apparatus is easily operated, and at small cost, and little space is needed.

"The water, even when the river is quite muddy, comes out limpid. In fact, the City of Cherbourg is quite satisfied with the mode of filtration which it has adopted."

The Mayor,

EMM. LIAIS.

Knight of the Legion of Honor.

THE FOLLOWING IS EXTRACTED FROM ANOTHER LETTER OF THE MAYOR OF CHERBOURG IN DATE OF SEPTEMBER 12TH 1898:

"The results of the Maignen System appear to us the best that could be expected of any system of filtration.

"It has the advantage of an easy and comparatively economical cleansing. It improves the water considerably and renders it perfectly clear.

"In fact it gives satisfaction to the City of Cherbourg."

The Mayor,

EMM. LIAIS.

Knight of the Legion of Honor.

Figure 10 shows the Cherbourg Municipal House erected on the reservoir which supplies the city.

Figure 11 is an interior view of same.

Figure 12 represents one of the London Sand Beds in process of cleansing.

Figure 13 shows a staff of men breaking the ice surface.

VITAL STATISTICS OF CHERBOURG.—The following is an account of the deaths that have occurred month by month, from 1894 to 1897 in Cherbourg, including the Garrison.

YEARS.	—MONTHS.—												TOTAL.
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
1894. -	164	111	138	129	106	85	83	76	75	60	58	83	1168
1895. -	109	158	125	89	92	77	68	64	61	89	70	67	1069
1896. -	98	94	79	82	71	75	94	85	86	76	74	87	1001
1897. -	90	89	101	89	63	62	57	65	71	-	-	-	687

For 9 months.

The population has increased yearly, and the reduction in the general death rate is equal to 6 per cent. per 1000.

TYPHOID FEVER.

YEARS.	Deaths in the garrison.	Deaths in the civil population.	
		Per 10,000 inhabitants.	
1894.	6.06	6.03	
1895.	10.30	4.68	
1896.	27.87	4.61	
1897.	23.45	3.63	

It will be observed that the rate has much increased in the garrison, whilst it has steadily diminished in the city.

The reason of this difference is not difficult to find. The garrison and a part of the city are supplied by a separate main, taking the water from the same river about two miles above the intake of the city. *But the water of this main is not filtered.* The supply to the city proper comes

from the reservoir, on which is installed the Maignen Asbestos Filtering Plant.

Some other diseases show a considerable reduction.

AVERAGE CASES OF THE YEARS.

	1894, '95, '96.	1897.
Measles and Complications, Scarletina,	55.3	5
Diphtheria and Croup,	14.6	3
Pneumonia,	67.3	34
Diarrhoea, Dysentery,	71.6	48

These figures were not needed to prove that death and disease could be diminished by filtration, but they show that the Maignen Asbestos system has had there a good practical trial.

CONCLUSIONS CONCERNING CHER-

BOURG.—One of the causes of our success in Cherbourg is the use of an asbestos cloth stretched over the layer of charcoal.

We obtain a better result with one of our latest improvements, which consists in making the asbestos felt membrane with asbestos fibre *on the sand layer*, as already described. *It is much cheaper and more easily handled.*

PARIS EXPERIMENTAL PLANT.—Paris has a double set of mains; one giving spring water sold by the city at about 24 cents a thousand gallons for drinking

purposes; the other, distributing ordinary river water for flushing the sewers, watering the streets and gardens, for fire hydrants and industrial purposes, at 12 cents a thousand gallons.

In dry years, the springs do not give all the water that is needed, and until lately it was necessary to use unfiltered River water for drinking purposes.

On the assumption that the residents in the rich quarters were in the country in summer, or could afford to buy mineral waters or filters, the disease bearing river water was distributed alternately among the better wards, the short supply of spring water being reserved for the poorer districts.

In 1894 and '95 a public competition was held by the Municipality of Paris for "the purification and sterilization of river water." 148 inventors sent in papers, 102 were eliminated at the first examination, 42 were considered on a second reading, 19 were admitted to a practical trial.

The report of the trial commissioners concluded in favor of *sand* and *asbestos* filtration.

The city had already erected large sand beds with continuous decantation tanks as seen in Fig. 14. Our asbestos filters having, in the trials, given the best practical results, we were allowed to erect a large filter plant on the grounds of the city, and close to the sand beds. A little

corner of our plant is seen on the right of Figure 14. Figure 15 shows the same, seen from the plain below; the tanks in front are our primary filters, the flat surface which is seen behind is the roof of our final filters.

Figure 16 is one of the four filter chambers composing our Paris experimental plant. The filtering elements are asbestos cloth sacks containing, as explained already, charcoal and asbestos cloth core. The attendant is washing off the outer surface of the filtering organs.

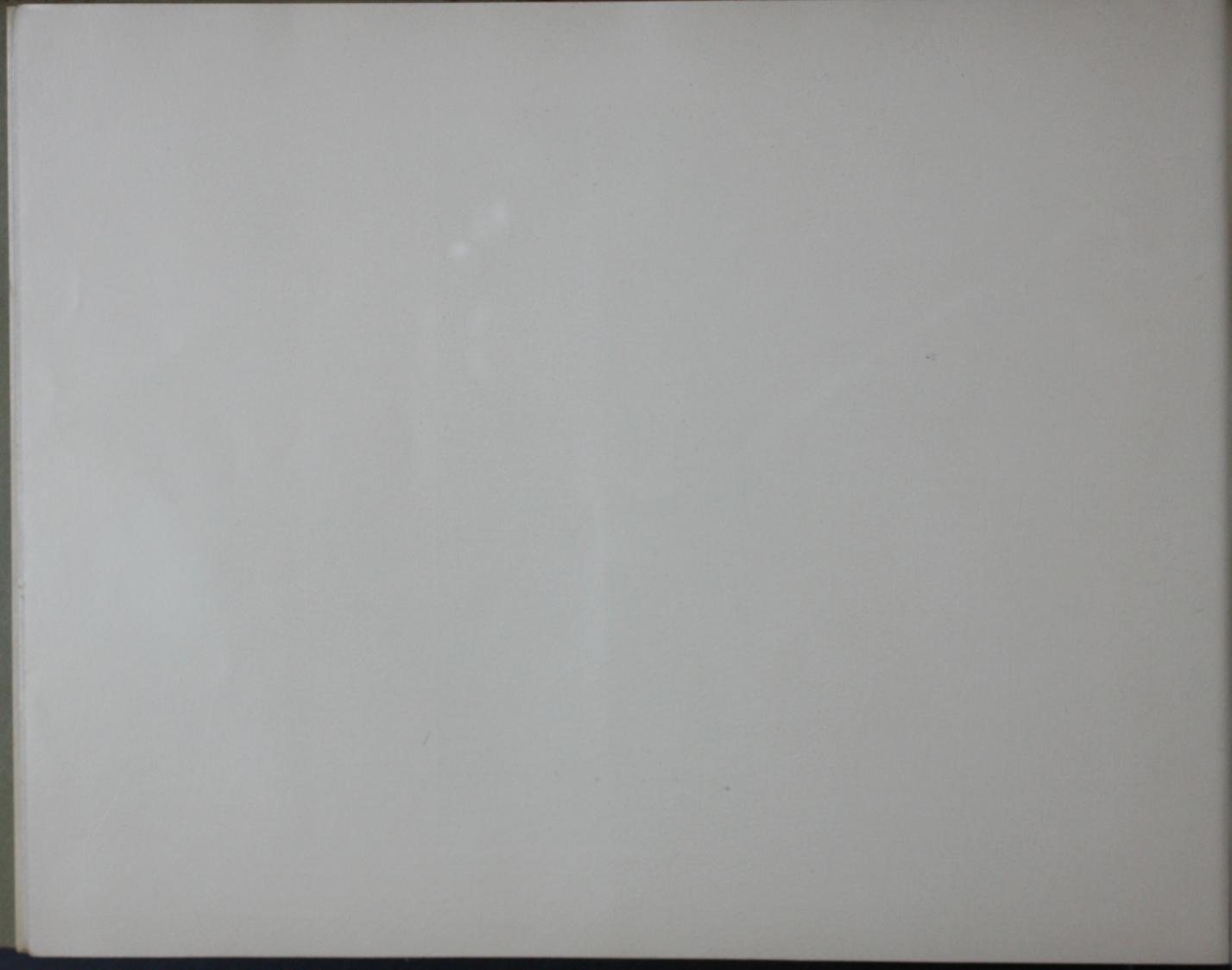
We have watched daily for a whole year the working of the two systems: plain sand beds and our asbestos system, and we have come to the conclusion that *by forming our asbestos felt membrane over the sand beds, and correcting the numerous defects which we found in the sand system, we would obtain the best practical and most economical results in dealing with very large supplies of water.* That is why we propose for the city of Philadelphia our **Improved Sand Filtration Process.**

In order to cope with the very bad water brought down in times of freshets, we consider it desirable to submit the Philadelphia water to a preliminary filtration when taken from the Reservoir, and to a double preliminary filtration if taken direct from the River, previous to its passage on to the improved sand beds.

For other waters, such as that of the Ohio at Cincinnati, we would add our asbestos filtering organs to finish the work which the sand cannot entirely accomplish.



Figure 1. One of Maignen's Filtering Organs Complete, as now supplied to the United States War Department, Washington.



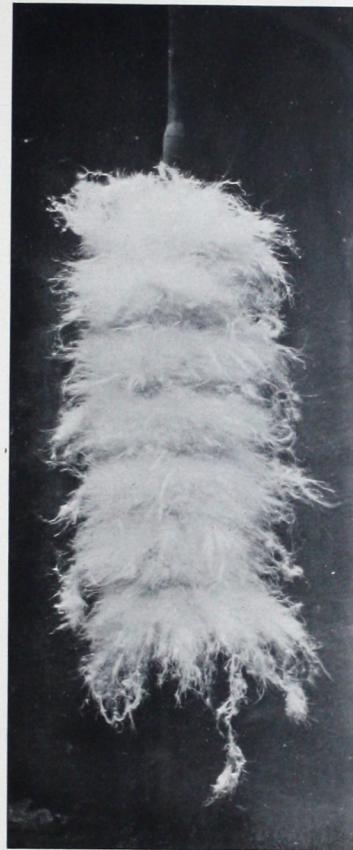


Figure 2. The Core of one of Maignen's Filtering Organs,
Showing the Asbestos Felted Cloth.



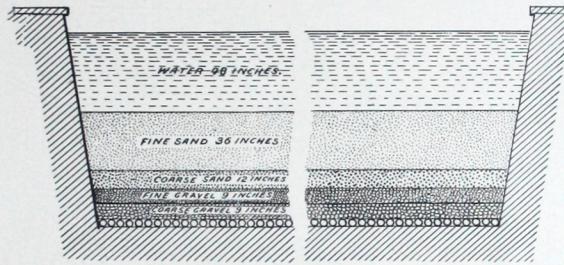


Figure 3. Section of an English Filter Bed.

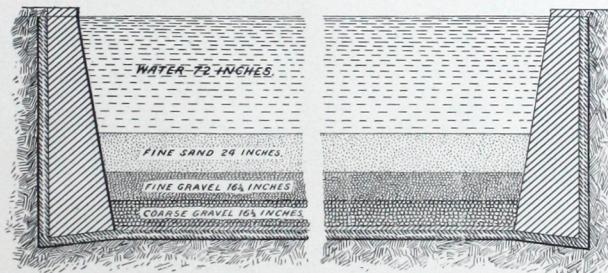


Figure 4. Section of a Berlin Filter Bed.



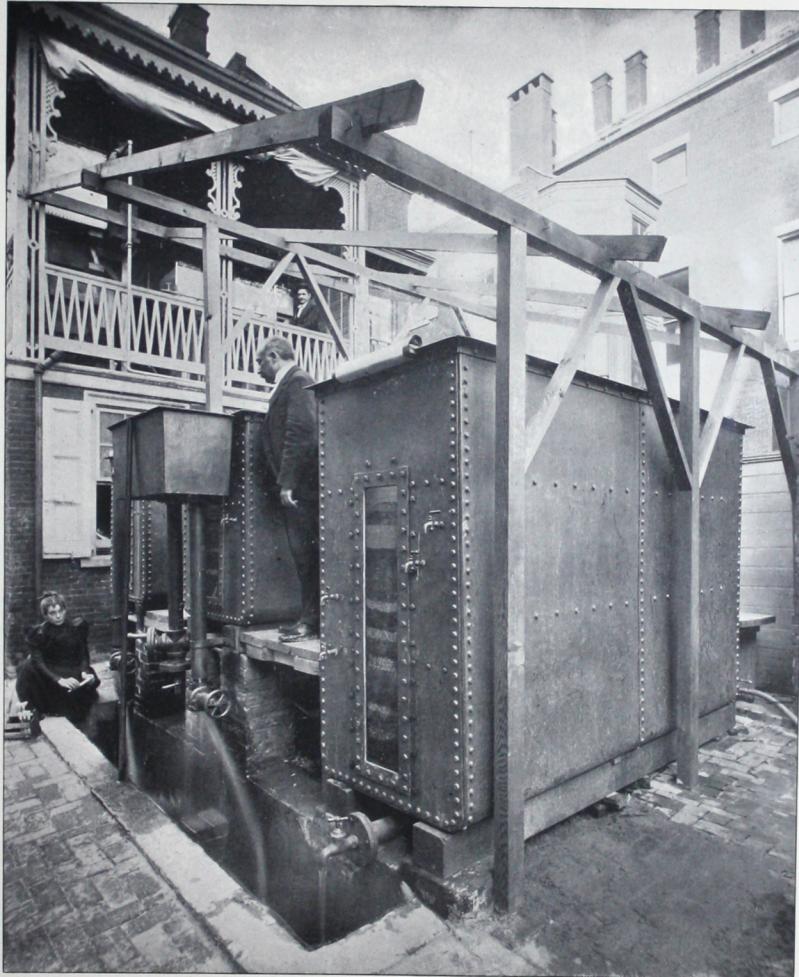
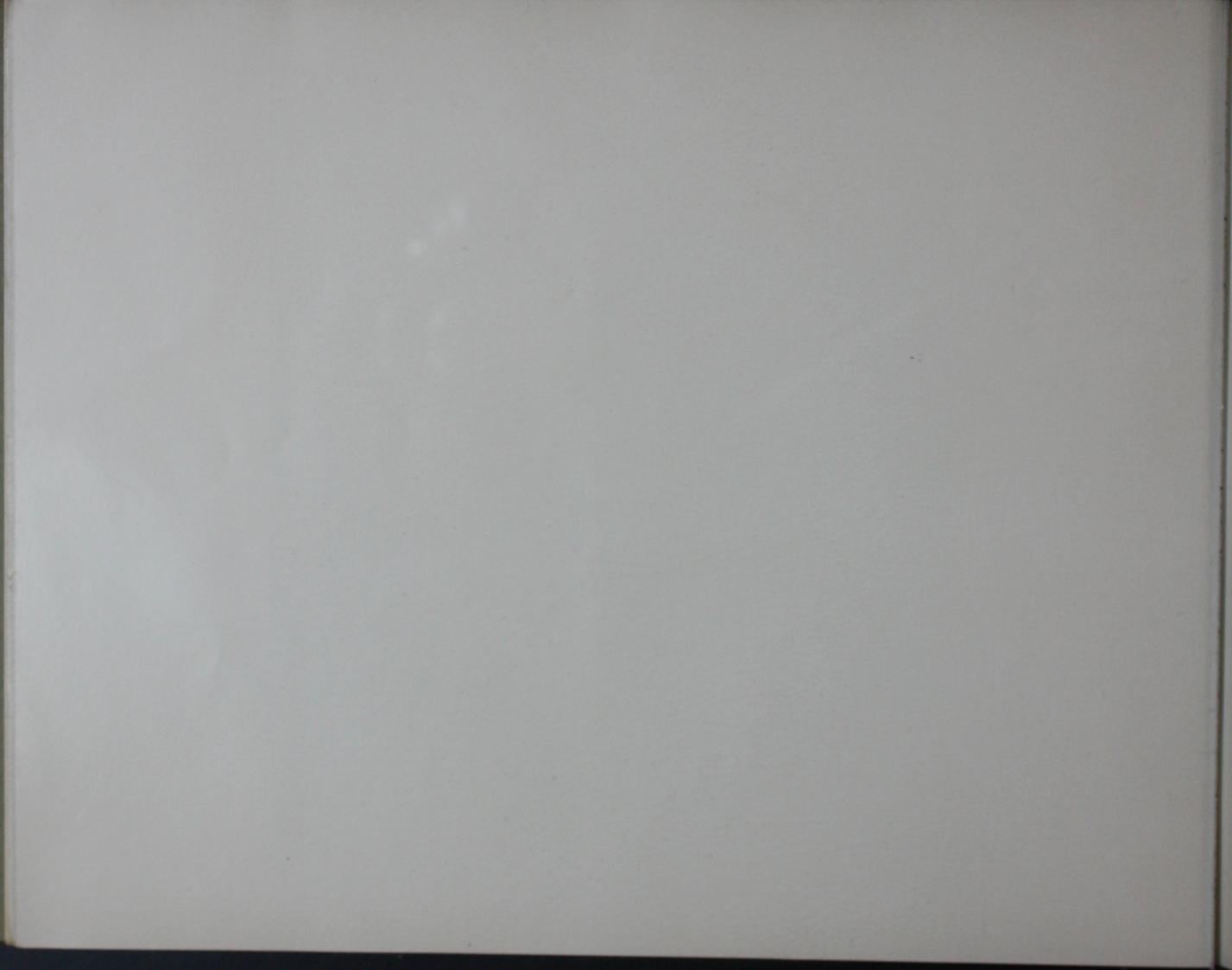


Figure 5. The Maignen Filtration Company's Experimental Plant.
1310 Arch St., Philadelphia.



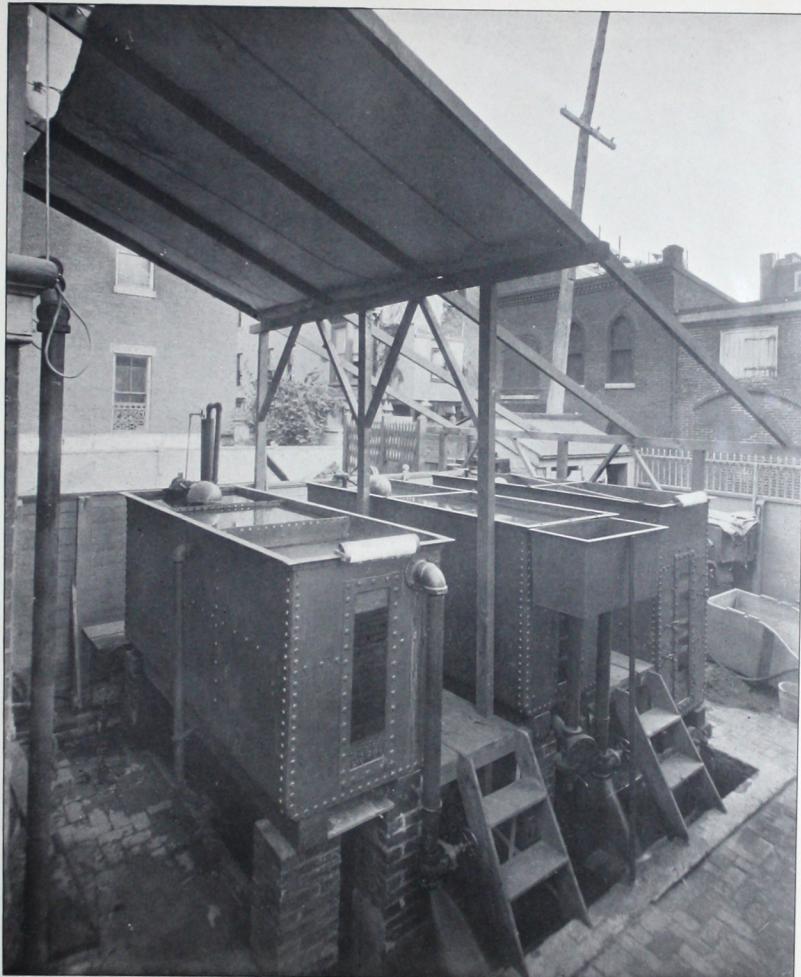
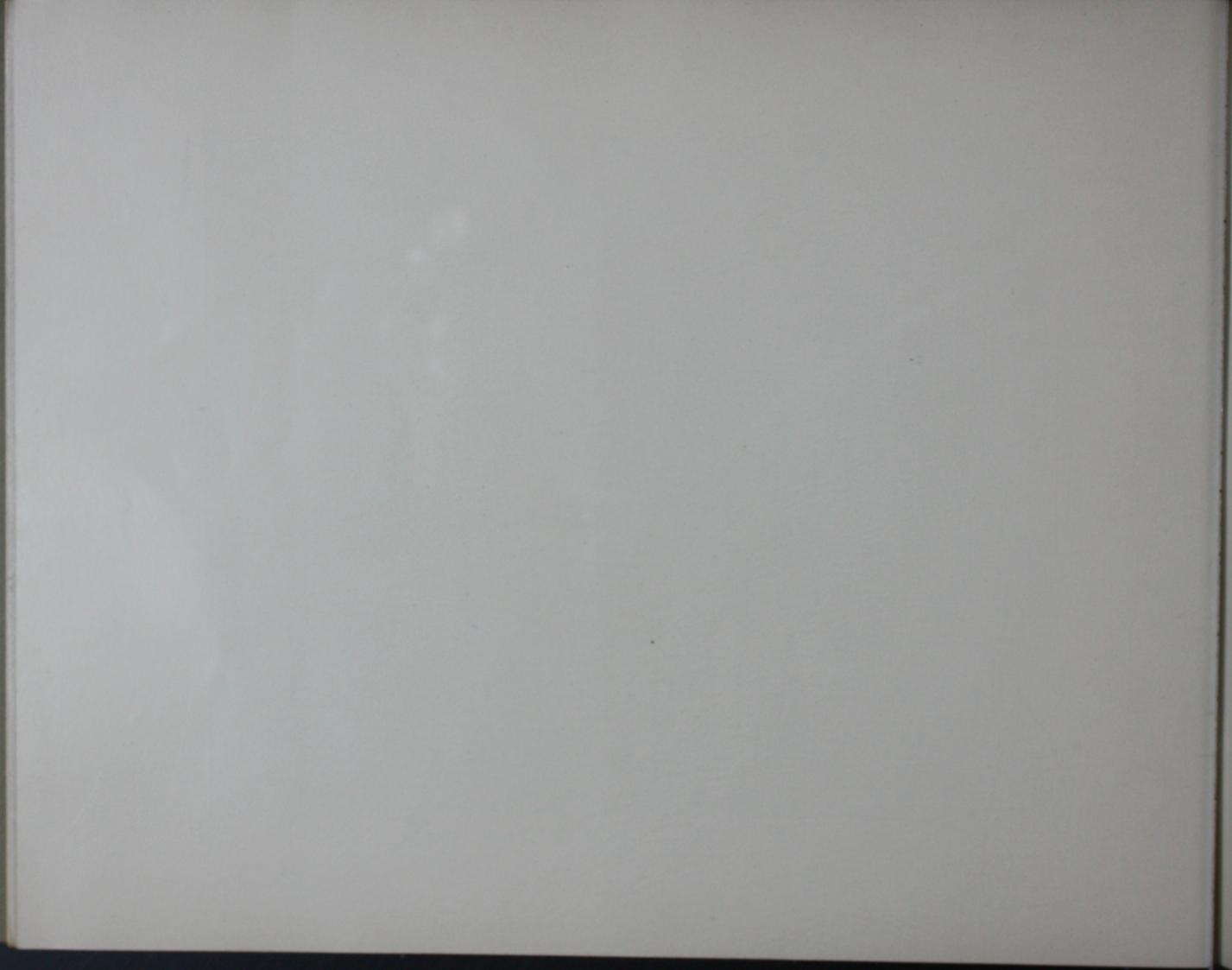


Figure 6. The Maignen Filtration Company's Experimental Plant.
1310 Arch St., Philadelphia.





Figure 7. Mr. Maignen's Bacteriological Laboratory.
Dr. Mary E. Gillespie, Director.



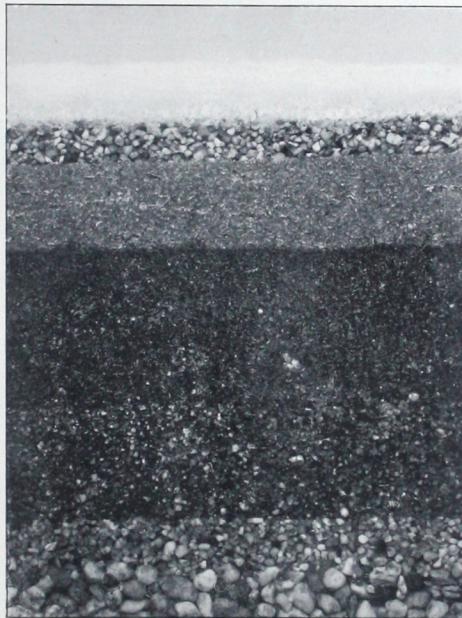


Figure 8. Maignen's Asbestos Felt Membrane
on Sand Bed.



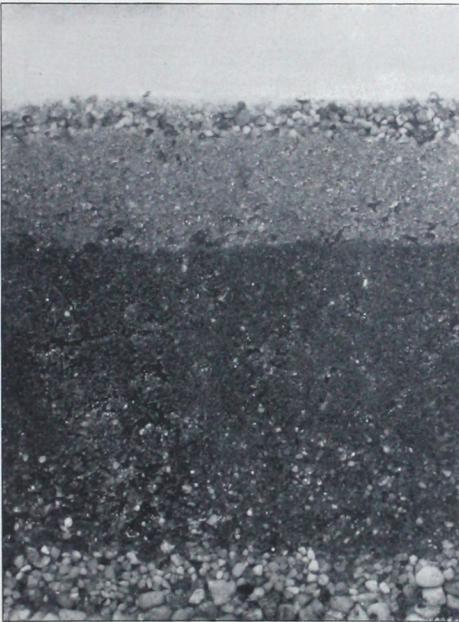


Figure 9. Caverns and Holes in Ordinary
Sand Beds.



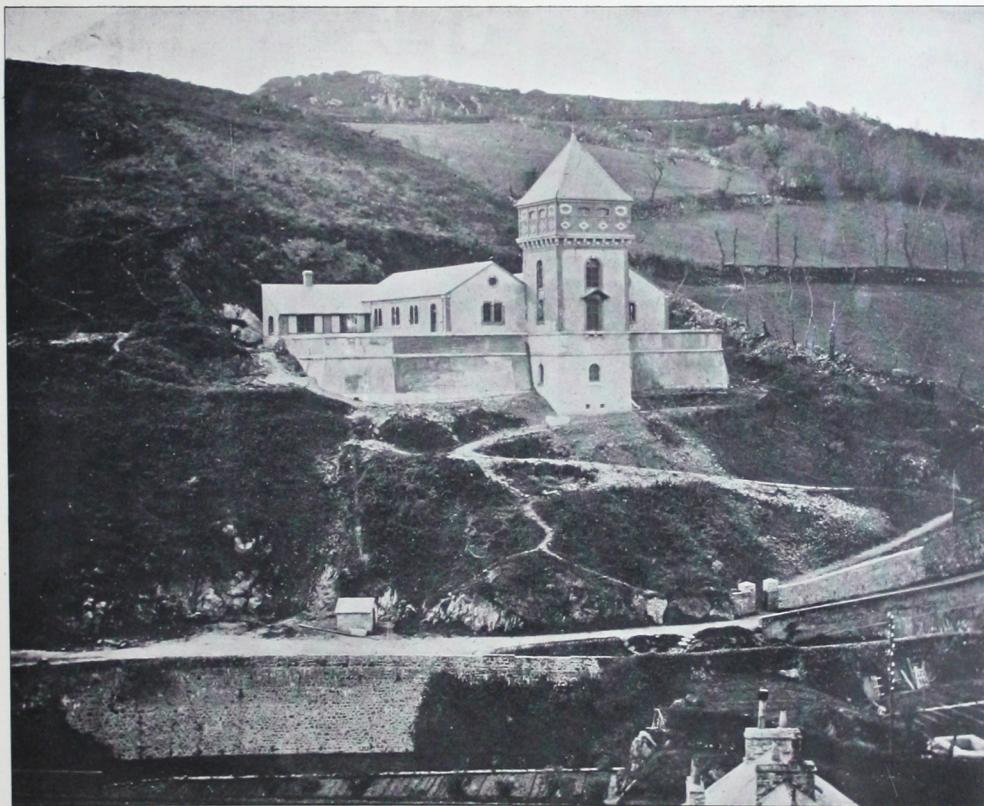


Figure 10. Cherbourg Municipal Filter House, Erected on City Reservoir.



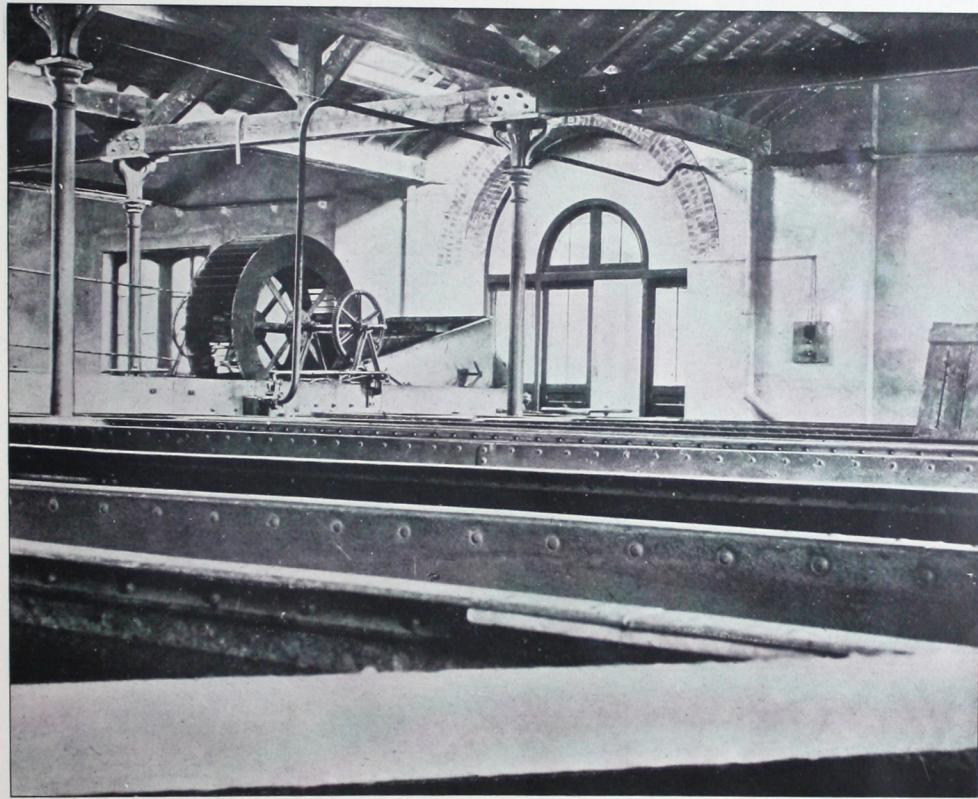


Figure II. Interior of Cherbourg Municipal Filter House.



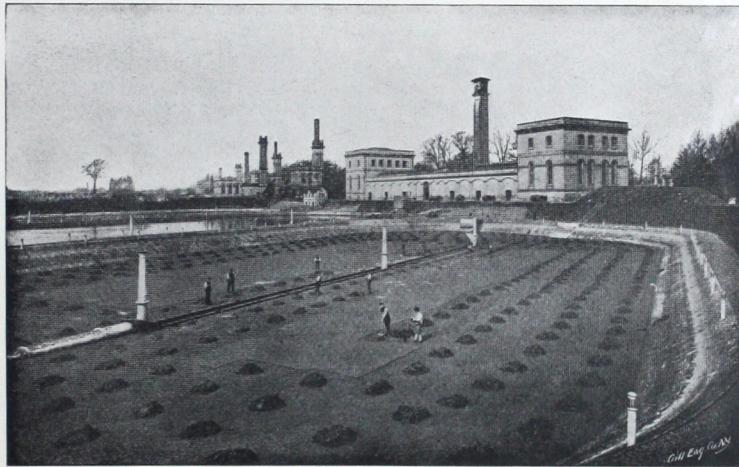


Figure I2. London Filter Bed under process of cleansing.
From Mr. W. P. Mason's "Water Supply."



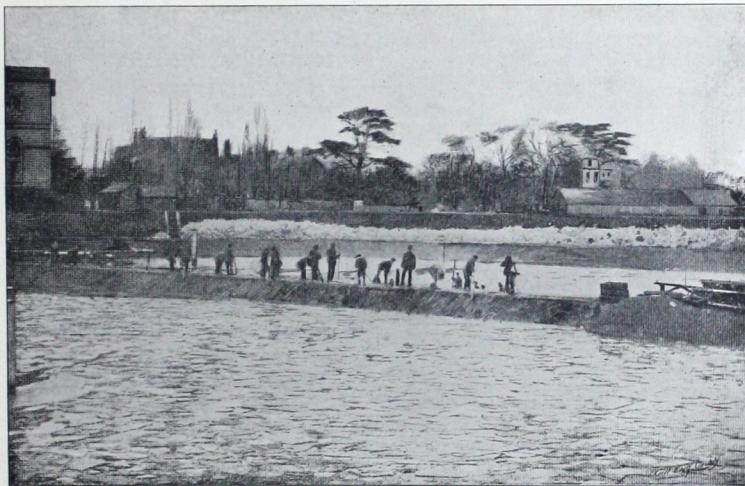


Figure 13. Breaking the Ice on a London Filter Bed.
From Mr. W. P. Mason's "Water Supply."



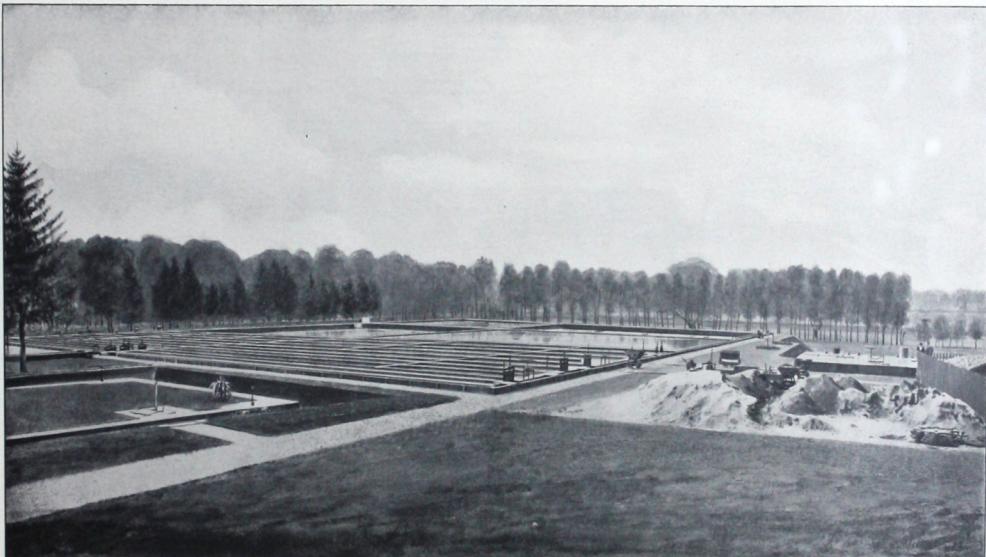


Figure 14. The City of Paris Experimental Filter Station, at St. Maur, France.



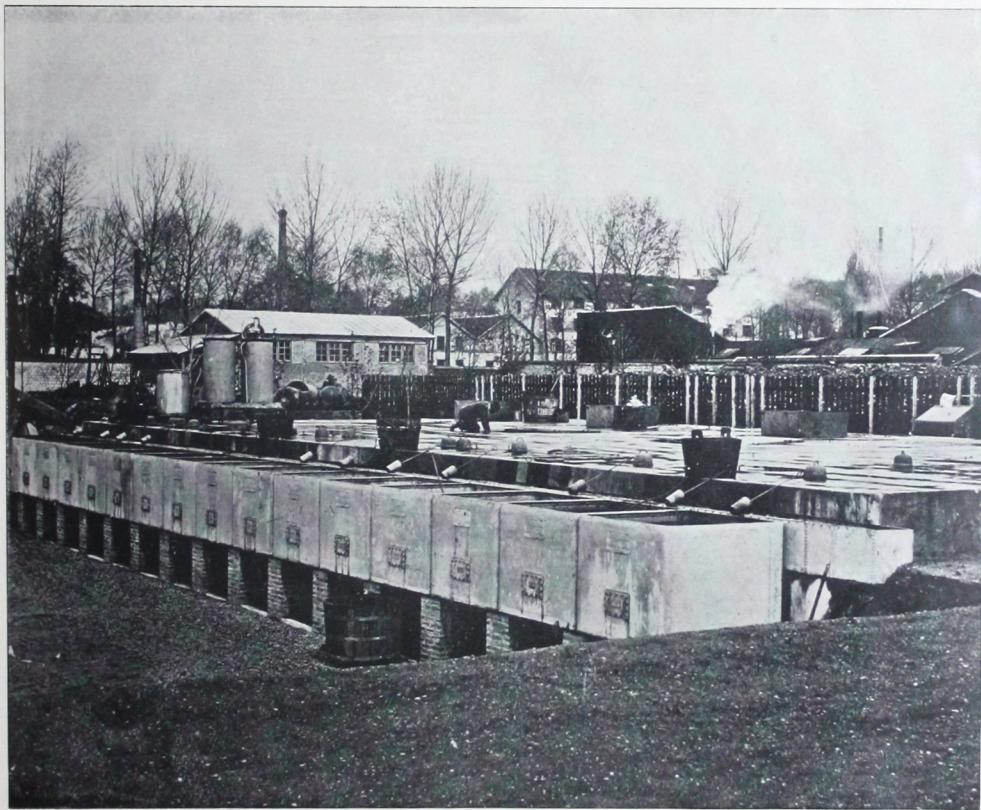


Figure 15. Maignen's Paris Experimental Plant. The tanks in front represent the primary filters.





Figure 16. Maignen's Paris Experimental Plant. Washing the filter surface.

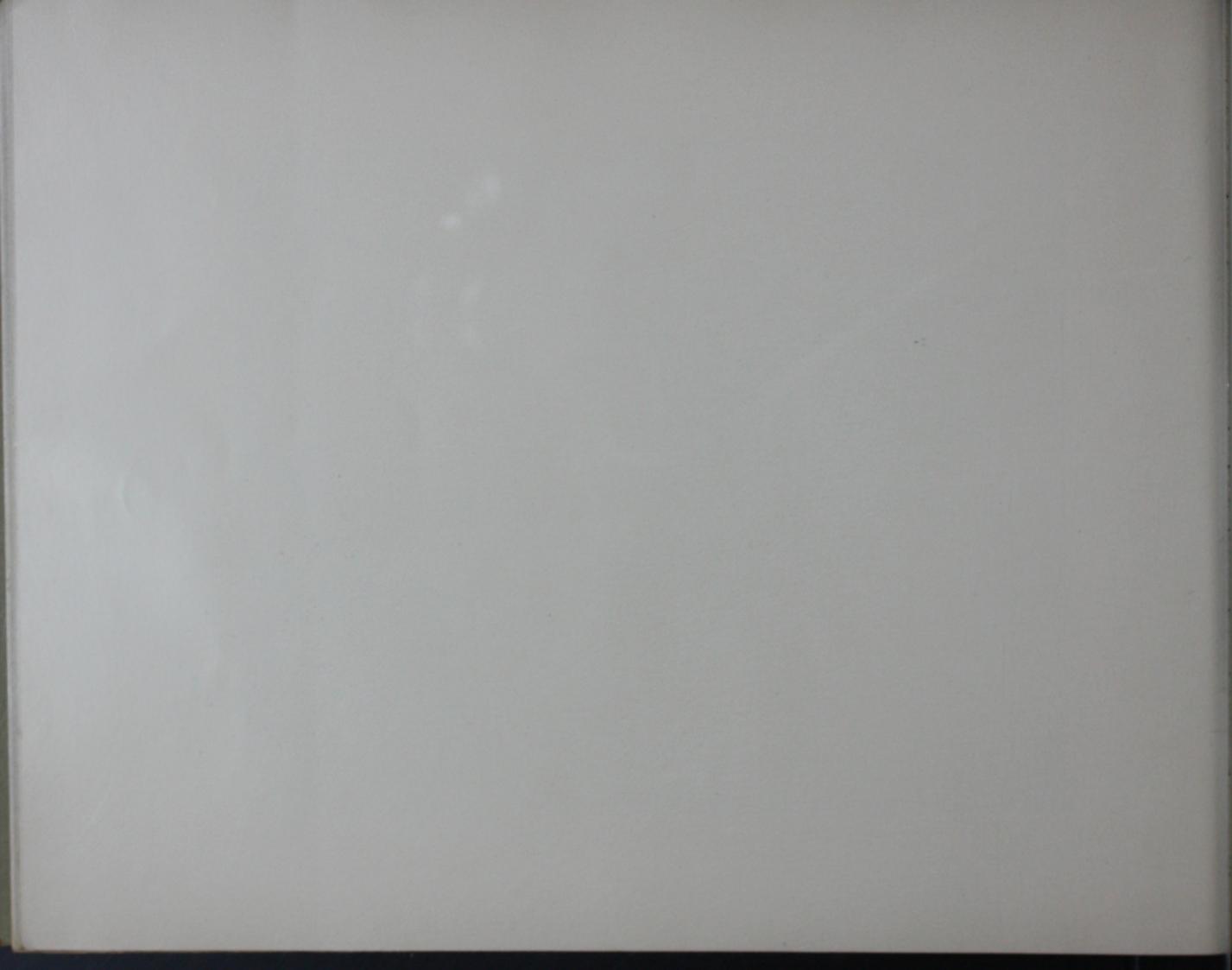




Figure 17.
Cherbourg Municipal Filtering Fountain—Maignen System.



Figure 18.

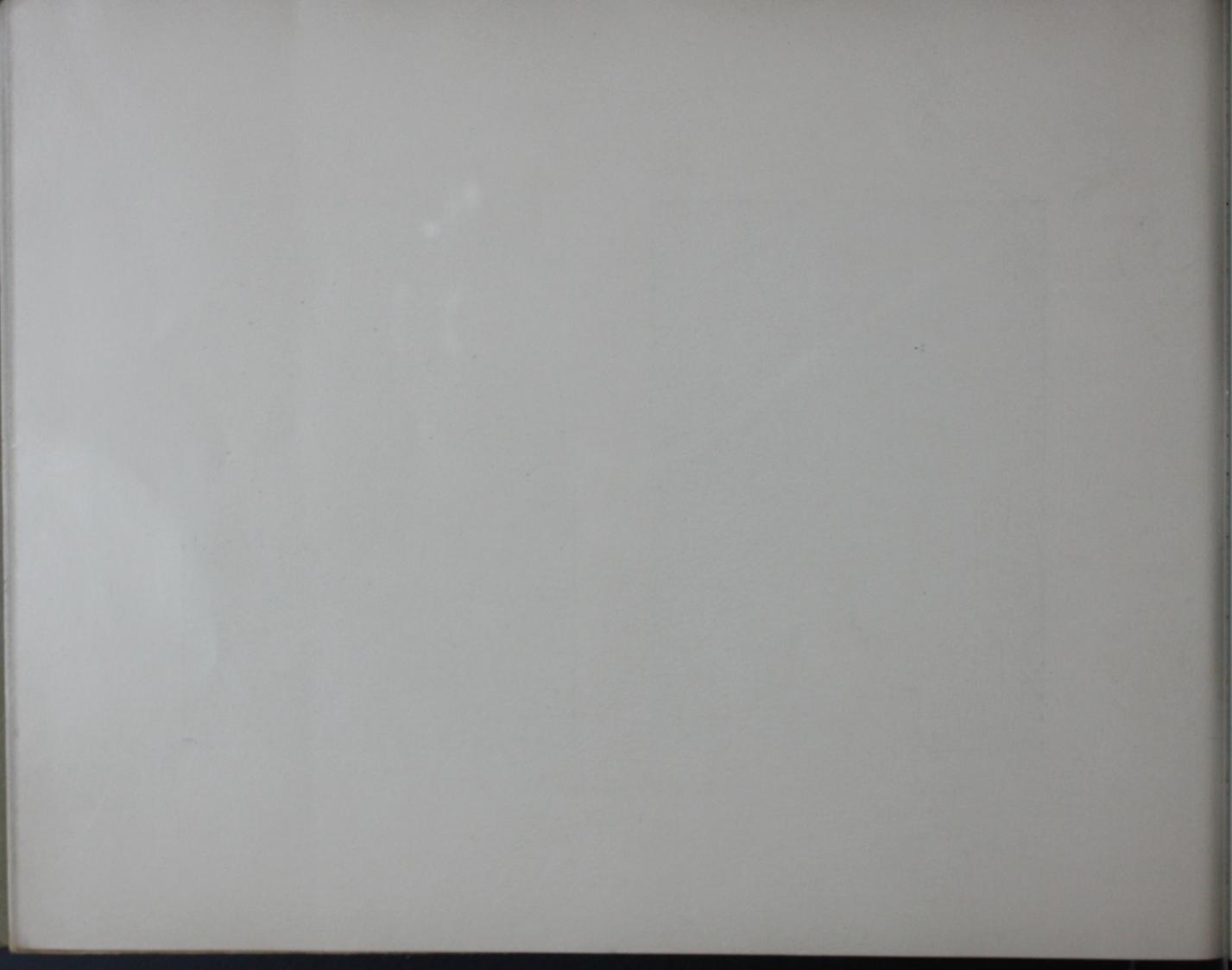




Figure 19.
Cherbourg Municipal Filtering Fountain—Maignen System.

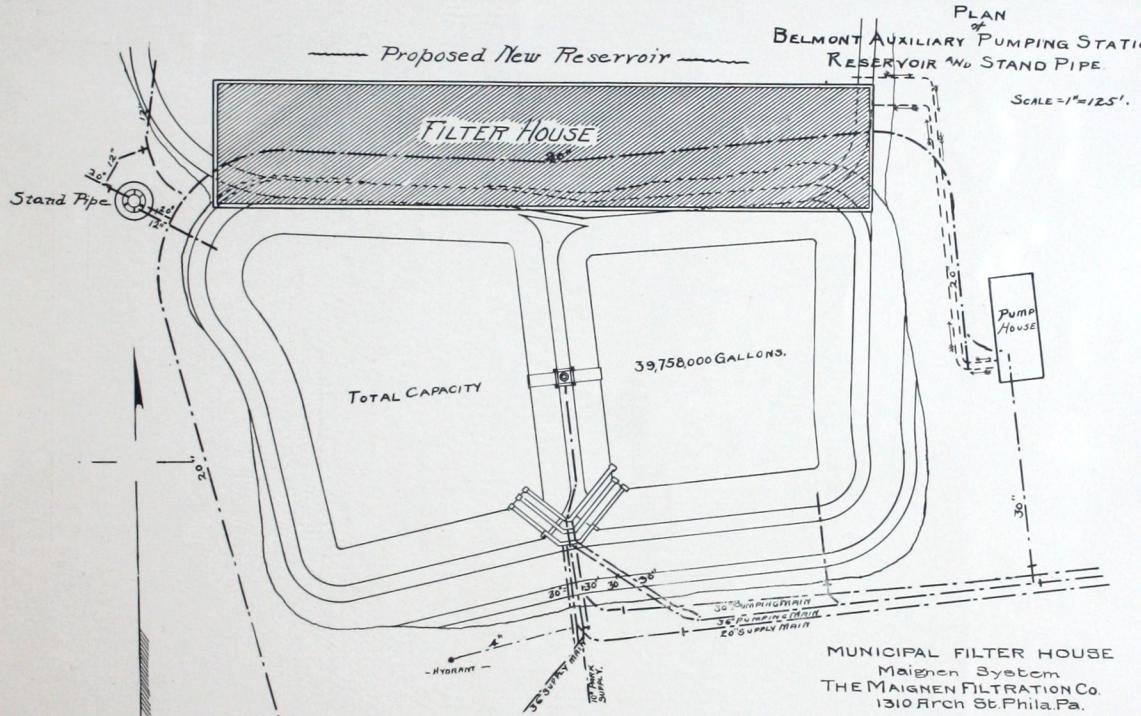


Figure 20.
Germantown Public Filtering Fountain.



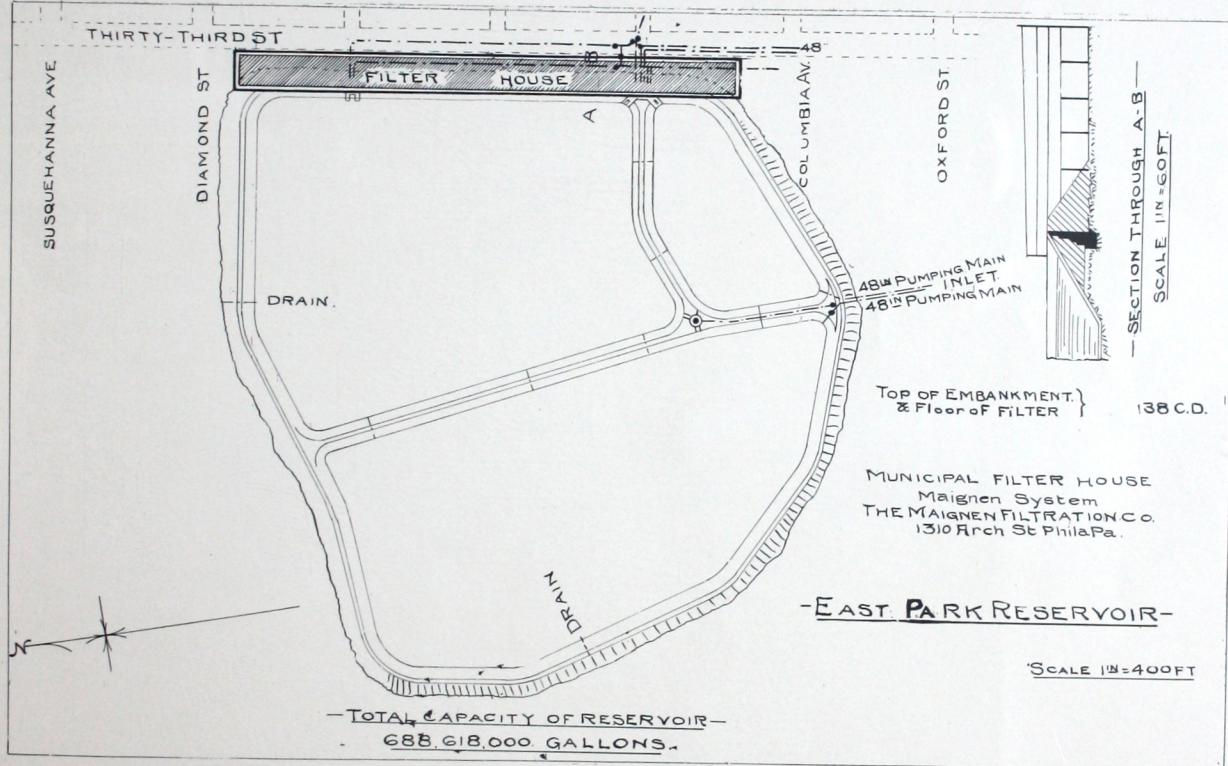
PLAN
of
BELMONT AUXILIARY PUMPING STATION
RESERVOIR AND STAND PIPE.

SCALE = 1" = 125'.



MUNICIPAL FILTER HOUSE
Maignen System
THE MAGNEN FILTRATION Co.
1310 Arch St. Phila. Pa.



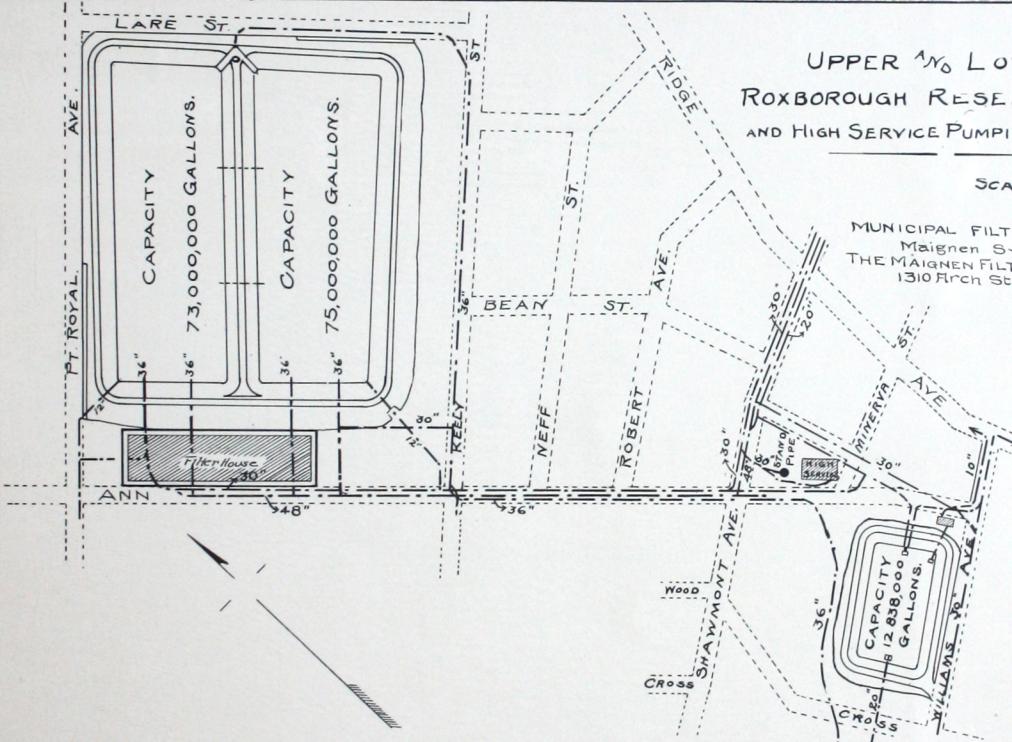


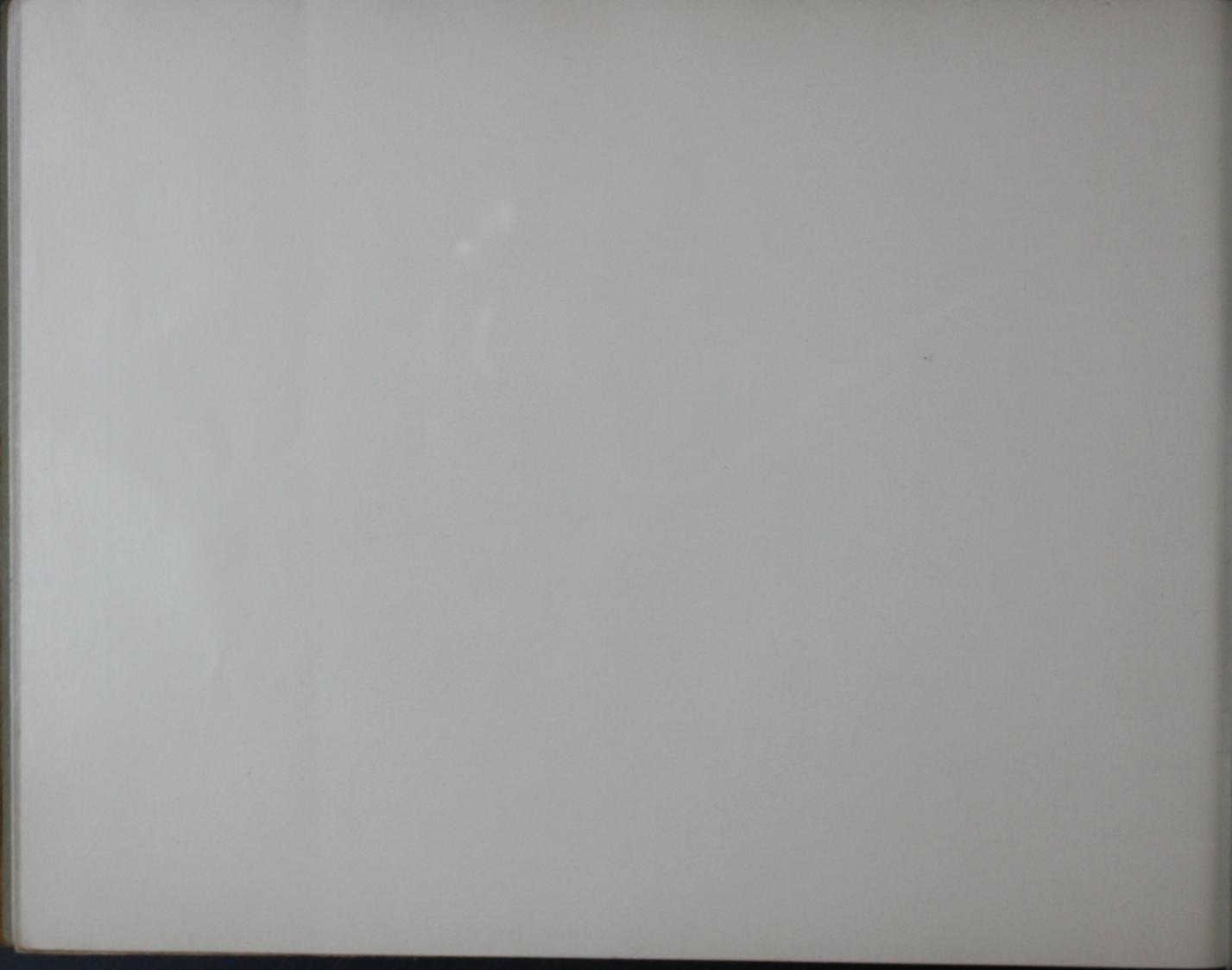


UPPER & LOWER
ROXBOROUGH RESERVOIRS,
AND HIGH SERVICE PUMPING STATION.

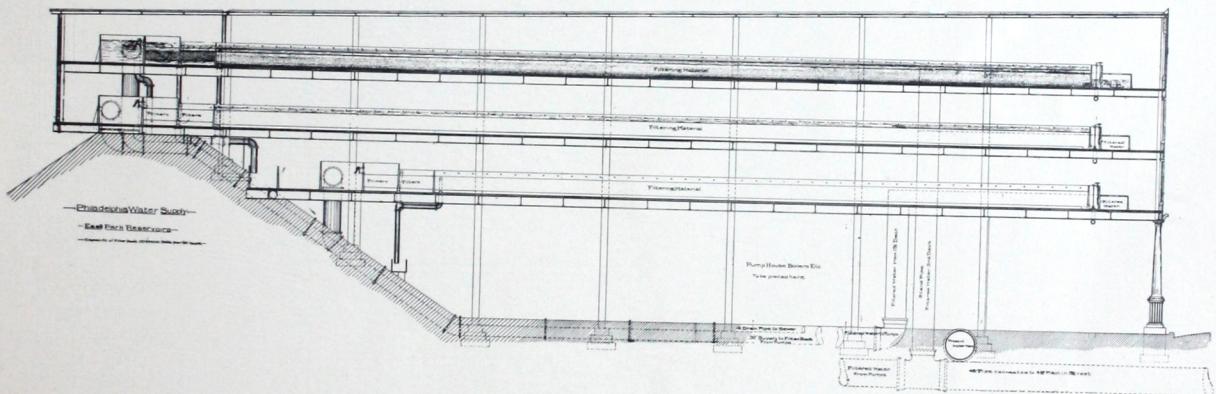
SCALE 1 IN = 300 FT.

MUNICIPAL FILTER HOUSE
Maignen System
THE MAIGNEN FILTRATION CO.
1310 Arch St Phila Pa.

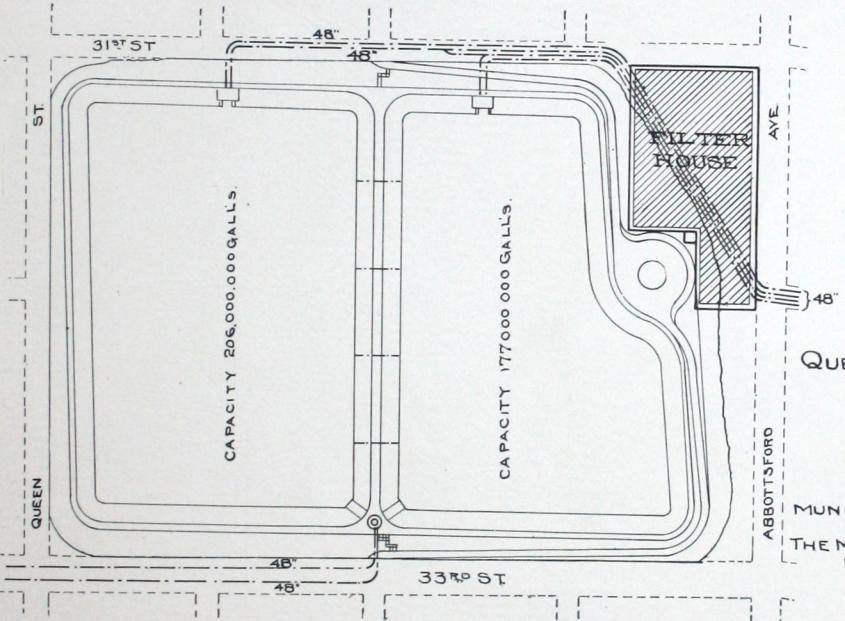




MUNICIPAL FILTER HOUSE
Maignen System



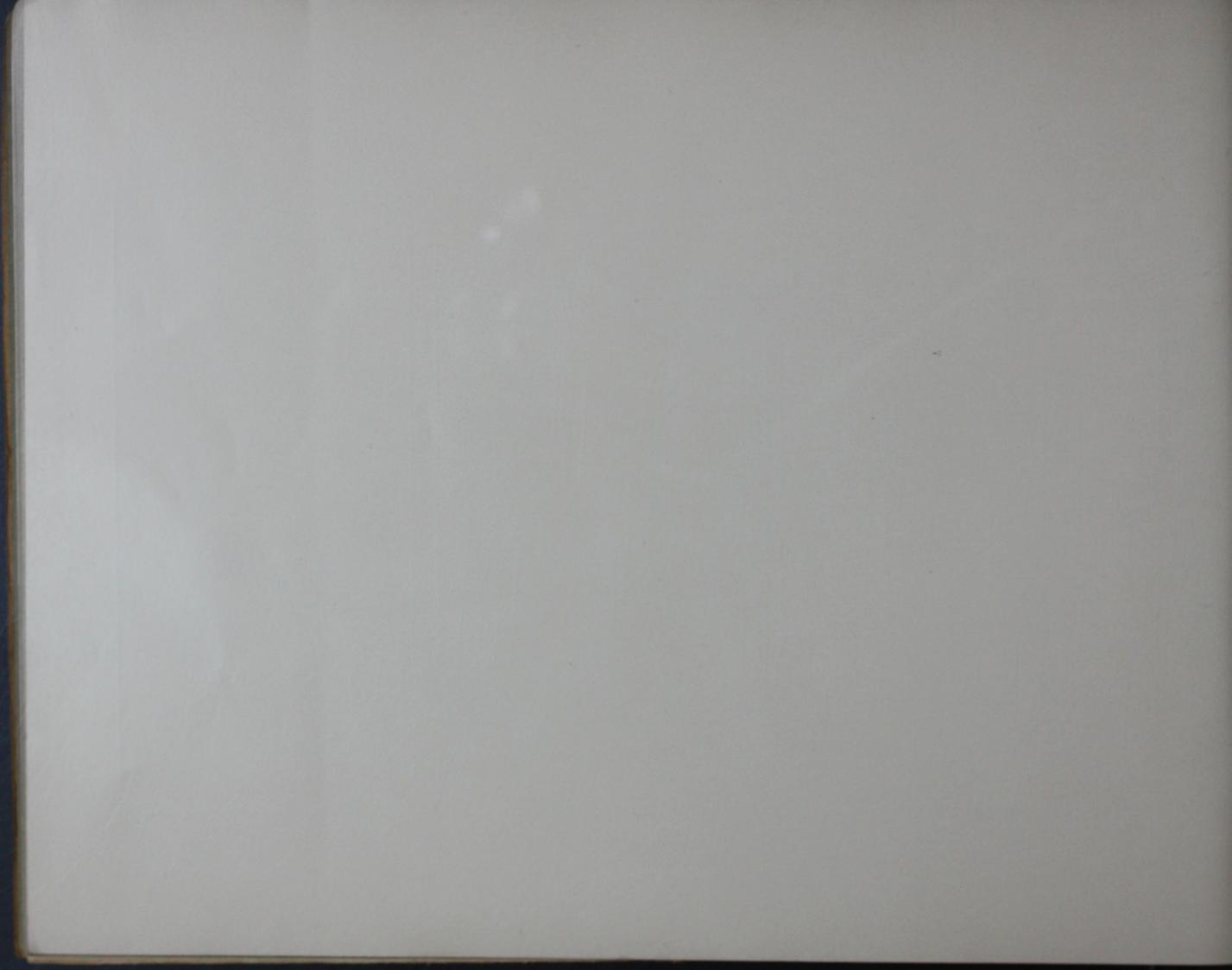


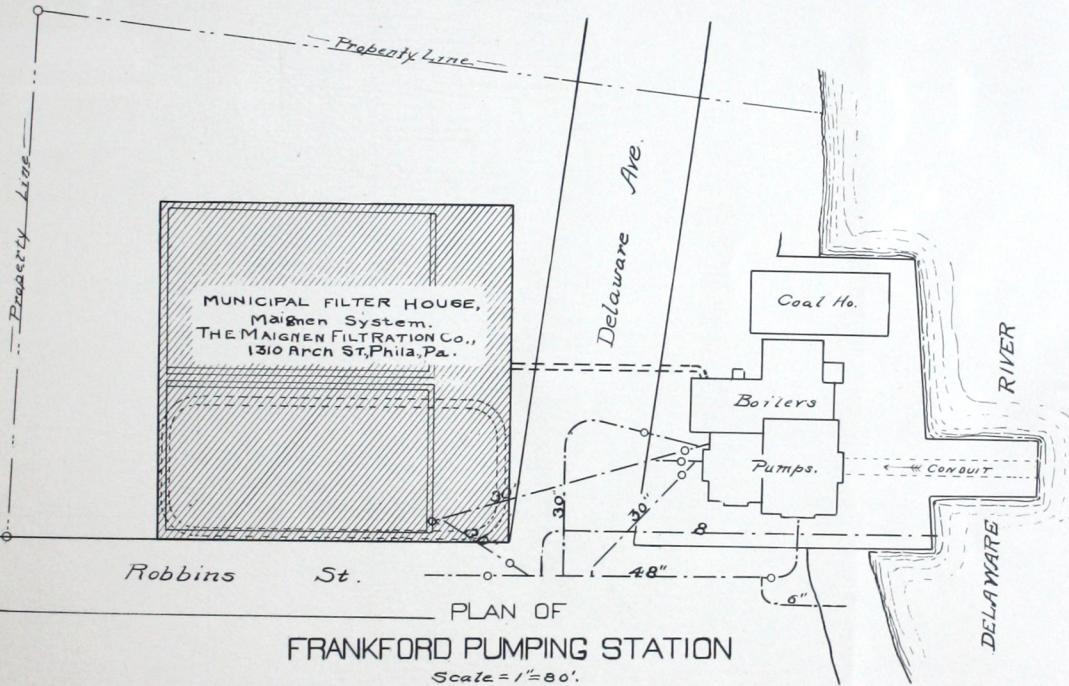


QUEEN LANE RESERVOIR

Scale 1: 200.

MUNICIPAL FILTER HOUSE
Maignen System.
THE MAIGNEN FILTRATION CO.
1310 Arch St. Phila. Pa.







WAR DEPARTMENT,
SURGEON GENERAL'S OFFICE,
U. S. ARMY MEDICAL MUSEUM AND LIBRARY,
Corner 7th and B Streets S. W.,

Washington, Oct 24, 1898

Mr. P.A. Maigren

1310 Arch St., Phila., Pa.

Dear Sir:-

I am directed by the
Surgeon General to request that you will furnish
40 maigrén's section filters of the same pattern as
hereofen supplied this department, with as little delay
as practicable. Ship by express to the Medical
Supply Officer, Army medical museum, Washington
D.C. paying the expressage and adding the same
to the cost of the goods.

Very respectfully,

J. H. Bushnell
Major and Surgeon at S.V.
Medical Supply Officer

Communications on official business should be addressed "To the Surgeon General, U. S. Army, Washington, D. C."
Subject:

In reply refer to No.

WAR DEPARTMENT,

Surgeon General's Office,

Washington, May 31, 1898.

Mr. P.A. Maigren.

1310 Arch Street,

Philadelphia, Pa.

Sir:

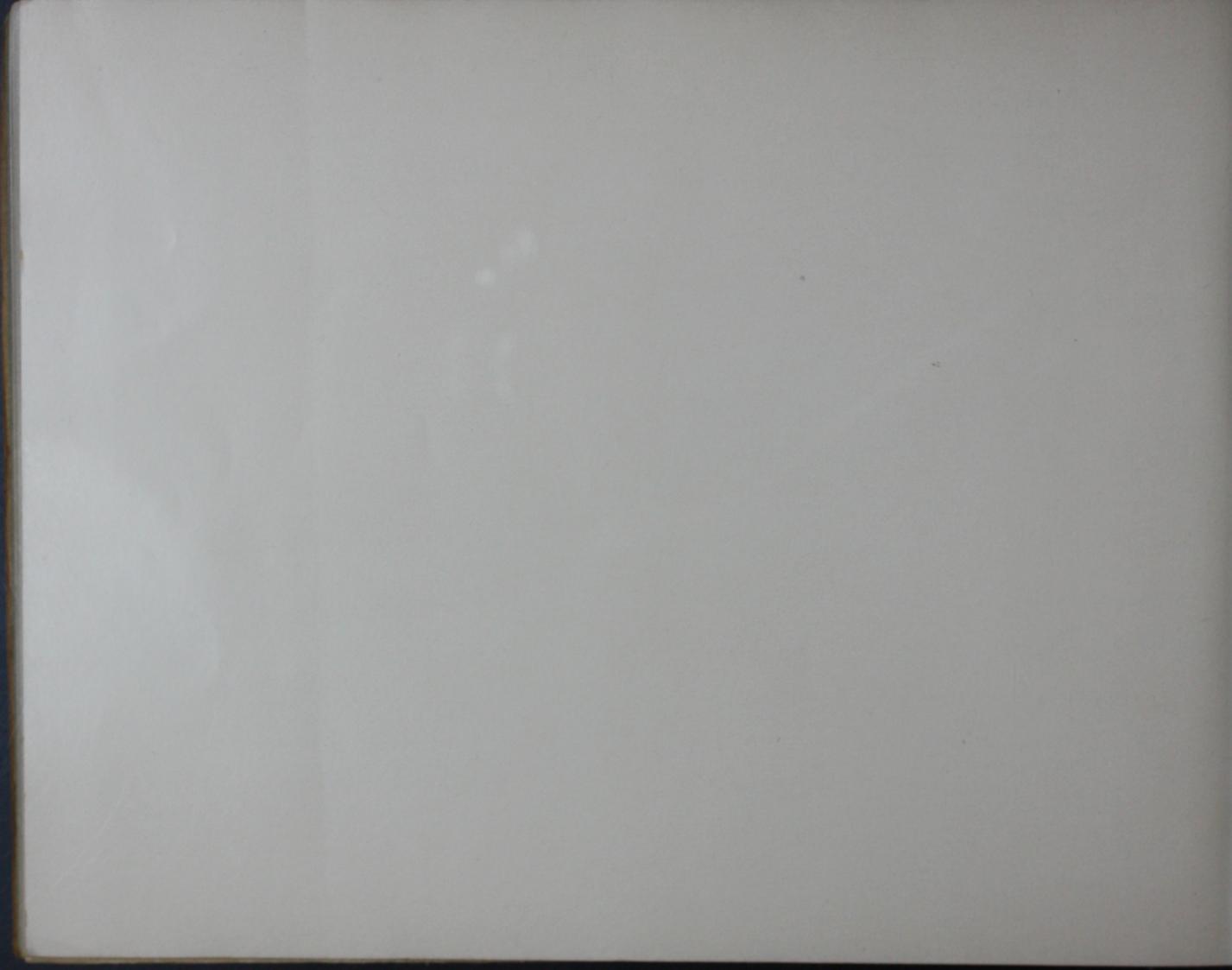
The Surgeon General requests you to furnish for the use of the
Medical Department, U.S.A., one hundred (100) Patent Section Water
Filters for Army use, with buckets and attachments like sample fur-
nished the Quartermaster's Department, at twelve dollars (\$12.00) each,
delivered to Capt. Geo. E. Bushnell, Asst. Surgeon, U.S. Army, Acting Medi-
cal Supply Officer, Army Medical Museum, Cor. 7th and B. Streets, S.W.,
Washington, D.C., with invoice.

Immediate delivery is urgently requested and bill for same
should be sent to this office for settlement.

Very respectfully,

G. N. Gladden

Assistant Surgeon General, U.S. Army.



MAIGNEN'S PATENT WATER FILTERS FOR ARMY USE

As Supplied to the War Department, Washington.

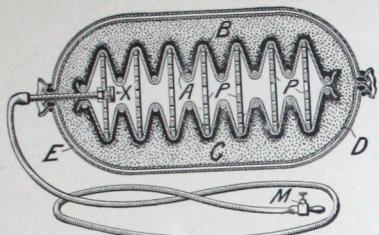


Fig. 2

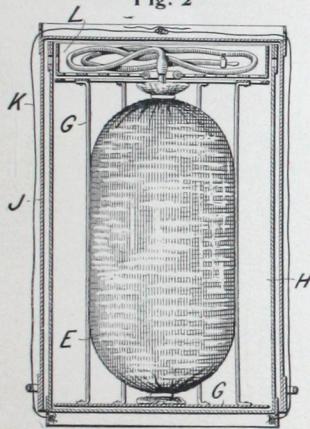


Fig. 3.

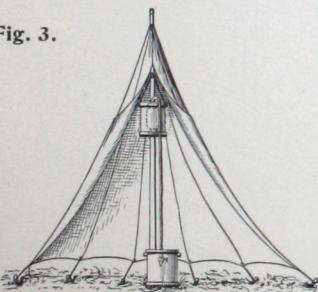


Fig. 1 represents the "Section" filtering organ.

- A—Is the inner asbestos cloth.
- B—The thin layer of pulverized "Carbo-Calcis."
- C—The thick layer of granular "Carbo-Calcis."
- D—Is the outer asbestos cloth.
- E—Is the extra asbestos cloth provided to protect the filtering organ proper, on account of the rough usage to which this filter is likely to be subjected in campaign.

Fig. 2 shows the filtering organ E in its filter case. It is protected from wobbling sideways by the Cage G and upwards by the Screen L.

- H—Is the filtering case in which the water to be filtered is put.
- J—Is the other bucket, which is taken off when filtering or drying, and is intended to receive the filtered water as in Fig. 3.

Fig. 4 represents the removal of the cage and filtering organ out of the filter case, for washing or drying.

Fig. 4.

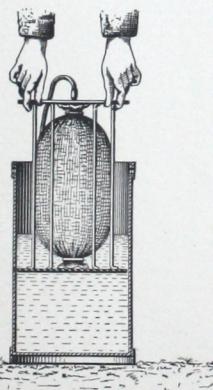


Fig. 5.

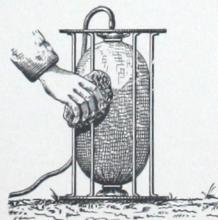
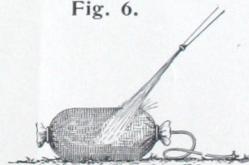


Fig. 6.



Two manners of washing the filtering surface.

